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The Bender II and its Relationship with Executive Functioning and Academics

Graduate Thesis

Submitted to the Faculty

Of the School Psychology Program

College of Liberal Arts

ROCHESTER INSTITUTE OF TECHNOLOGY

By

Katharine A. Warsinske

In Partial Fulfillment of the Requirements

for the Degree of

Master of Science and

Advanced Graduate Certificate

Rochester, New York

(date)

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### Abstract

The Bender-Gestalt Test and tests of executive functioning have been linked to academic achievement. The purpose of this study was to examine the validity of the Bender II as compared to Koppitz's Developmental Scoring System (DSS), as well as to determine the relationship between the Bender II and executive functioning. A total of 82 children participated in this study. A significant correlation was found between the DSS and the Bender II, with the Bender II mean approximately 10 standard score points higher than the DSS. The Bender II was also significantly correlated with more scales on the BRIEF than the DSS, indicating greater utility. The DSS and the Bender II were significantly related to students' reading and math achievement scores.

## The Bender-II and its Relationship to Executive Functions and Academic Achievement

### I. Visual-Motor Integration

Despite being developed in 1938, the Bender Visual-Motor Gestalt Test continues to be ranked among the top ten most frequently used assessment instruments for children, adolescents and adults (Piotrowski, 1995). The Bender-Gestalt was developed by Loretta Bender, who used nine of Max Wertheimer's figures to study the Gestalt function. She described the gestalt function as

that function of the integrated organism whereby it responds to a given constellation of stimuli as a whole; the response itself being a constellation, or pattern, or gestalt. All integrative processes within the nervous system occur in constellations, or patterns, or gestalten. The whole setting of the stimulus and the whole integrative state of the organism determine the pattern of response. (Bender, 1938, pp.3-4)

Bender studied the way children (ranging in age from 3 to 11 years) copied these figures onto paper. Three-year-olds have trouble reproducing the Bender-Gestalt figures, but are able to control their scribbling. A 4-year-old is able to make circles and closed loops that are required by some of the Bender-Gestalt figures. Five-year-olds may be able to make square-like figures and manipulate their circles into ovals or other elliptical shapes. By 6, a child can produce diamond shapes, vertical lines, dots, and can cross wavy lines. Children age 7 and older improve on these abilities and can add more detail (Bender, 1938).

The Bender-Gestalt was developed to be a measure of visual-motor development, which develops as a child's mind develops. It is "a fundamental function thought to be associated with

various functions of intelligence such as visual perception, manual motor ability, memory, temporal and spatial concepts, and organization” (Bender, 1938, p. 112). These functions are important in a child’s ability to succeed in school.

While the Bender-Gestalt was primarily developed as a test of visual-motor ability, there have been many other uses for this tool. These uses include the following: to screen for school readiness, to predict school achievement, to diagnose reading and learning problems, to evaluate emotional difficulties, to determine a need for psychotherapy, to diagnose brain injury, and to study mental retardation (Koppitz, 1963). However, scoring on the Bender-Gestalt was subjective and not normed on typically developing children, which could make interpretations questionable.

Another popular test of visual-motor integration is Beery’s Developmental Test of Visual-Motor Integration (VMI) (Beery, 1997) which, like the Bender-Gestalt, was designed to assess one’s ability to integrate visual and motor abilities. The VMI is a set of geometric figures that children copy with paper and pencil. Unlike the Bender-Gestalt, which children complete on a blank sheet of paper, each figure of the VMI is drawn in its own box. Because the VMI and the Bender-Gestalt both purport to measure visual-motor integration, they have been used interchangeably in school evaluations (Wallace & Larsen, 1978 as cited in DeMers, Wright, & Dappen, 1981). However, comparisons of these tests have shown that while the VMI and Bender-Gestalt are correlated, they display only a limited practical inter-test reliability and it appears that the Bender-Gestalt may be tapping slightly different skills (Aylward & Schmidt, 1986; Brown, 1977; DeMers & Wright, 1981; Porter & Binder, 1981). Therefore, the rest of the studies in this paper will examine the Bender-Gestalt Test as it measures visual-motor integration.

### *Koppitz's Developmental Scoring System*

In 1963, Elizabeth M. Koppitz published her book, The Bender Gestalt Test for Young Children. Within this book, she describes a scoring system which analyzes errors made by the children. There were 20 deviations and distortions used as the initial scoring categories (Koppitz, 1963). (see Appendix 1).

Analysis of these 20 scoring categories revealed that only seven were related to school achievement. These include: (a) distortion of shape, (b) rotation, (c) substitution of circles or dashes for dots, (d) perseveration, (e) failure to integrate parts of a figure, (f) substitution of angles for curves, and (g) extra or missing angles. Through further analysis of the seven categories of error, it was also found that only for figures A, 3, 5, and 7 was distortion of shape significant. Most of the other categories are used to score more than one of the Bender shapes (Koppitz, 1963).

Using these seven categories differentiated between the high achievers and low achievers of the sample group (Koppitz, 1963). Therefore, school achievement in the elementary school grades is related to three aspects of visual-motor perception. The child must be able “to perceive a design as a limited whole and to be able to start and stop an action at will” (Koppitz, 1963 p. 9). The child must also be able to perceive lines and slants in regard to their direction, that is, discern and reproduce letters and numbers. Finally, the child must be able to integrate parts into a whole (Koppitz, 1963).

Being able to reproduce designs in the Bender-Gestalt Test also requires fine motor development, perceptual discrimination ability, and the ability to integrate the perceptual and motor processes. Children also need to be able to shift their attention from the original figure to

the copy. Inaccurate representations can be the result of misperception, execution difficulties, or difficulties in the memory storage or retrieval systems (Sattler, 1992).

While the other 13 categories are not significantly related to the achievement level of a child, they are related to other factors. For example, deviations such as erasing, redrawing of a figure, constricting the items to less than half a sheet of paper, or substituting dots or dashes for circles seemed to indicate tension or anxiety (Koppitz, 1963). Koppitz, in her book The Bender Gestalt Test for Young Children, reviewed several studies done in the 1950s with children with emotional disturbances. She also included her own study on this topic. Overall, she concluded that the Bender-Gestalt can differentiate between children with emotional disturbances from those without. Children with more emotional indicators present in their figures were more disturbed than children with fewer (Koppitz, 1963). There are eleven emotional indicators: confused order, wavy line, dashes for circles, progressive increase in size, large size of drawings, small size of drawings, fine line, overwork, reinforced lines, second attempt, expansion, and constriction. (For further review of these indicators and what they represent see Koppitz, 1963, 1975.)

There have been mixed findings as to the predictive validity of the Bender-Gestalt Test for academic achievement. One study in 1974 by Coy investigated this with 51 third-grade students who were given measures of math and reading achievement along with the Bender-Gestalt Test. While this study failed to show predictive validity of the Bender-Gestalt Test for reading and math achievement, it did find that integration errors occurred significantly more often with children in the low reading group (Coy, 1974). McKay and Neale (1985) also found predictive validity when examining the error type rather than the total number of errors. The



distortion category and the “circles for dots” categories offered the most predictive validity of later reading and writing ability.

Wright and DeMers (1982) found that visual-motor ability as measured by the Bender-Gestalt Test did not make its own contribution to the prediction of achievement (reading, spelling, and arithmetic) when other developmental abilities are controlled. Lesiak (1984) reviewed the literature between 1962 and 1981 regarding the Bender-Gestalt Test and reading achievement. She concluded that the Bender-Gestalt Test “adds little or nothing to the predictive utility of most standardized reading readiness tests” (Lesiak, 1984, p. 402).

Bender (1970) criticized the Koppitz scoring system for not being “global” in nature. Referring to Koppitz’s Developmental Scoring System (1963) and other scoring systems that count the number of errors, Bender writes, “This fails to take into consideration the essential global nature of the gestalt function, the inseparableness of the perceptual and motor capacities, and the inherent nature of maturation in all mental, personality and organismic functions, including the gestalt function (Bender, 1970, pp. 32).” Other scoring systems such as the Qualitative Scoring System for the Modified Version of the Bender-Gestalt Test (Brannigan & Brunner, 1989) have taken this into account when developing their scoring system and strived for a more global approach to the scoring of the gestalt figures.

#### *Other Scoring Systems for the Bender-Gestalt*

Other Bender-Gestalt scoring systems have been developed to differentiate between individuals with brain damage, psychopathology, and neurological impairment (Brannigan & Decker, 2003). In 1966, deHirsch, Jansky, and Langford (as cited in Brannigan & Decker, 2003) developed a simplified scoring system using only six of the nine figures used by Bender. It was used to predict reading performance in young children. The scoring system was based on the

number of figures on which the child failed to replicate the critical features (Brannigan & Decker, 2003). In 1989, Brannigan and Brunner (as cited in Brannigan & Decker, 2003) refined this system, developing the Qualitative Scoring System for the Modified Version of the Bender-Gestalt Test. This system used the six figures used by deHirsch, Jansky, and Langford and scored them on a 6-point system. Because the harder figures were eliminated, it was thought to be easier for younger children, while still providing opportunity to reproduce enough figures for a good sample of the child's ability (Brannigan, Aabye, Baker, & Ryan, 1995). Using a normative sample of 1,100 preschool and primary school children, this scoring system was found to be more reliable and valid than the Koppitz Developmental Bender Scoring System (1963) in predicting school achievement.

#### *Validation of the Qualitative Scoring System*

Several studies throughout the 1990's further validated the Qualitative Scoring System for the Modified Bender-Gestalt Test (Brannigan, Aabye, Baker, & Ryan, 1995; Brannigan & Brunner, 1991; Brannigan & Brunner, 1993; Schachter, Brannigan, & Tooke, 1991). Brannigan et al. (1995) found that the Qualitative Scoring System for the Modified Bender-Gestalt Test was valuable in identifying children with potential school problems. Approximately 400 children, first through fourth grades, were given the Bender-Gestalt Test. Each test was then scored using the Developmental Scoring System (developed by Koppitz, 1973) and the Qualitative Scoring System. The children were also given the Metropolitan Achievement Test to measure their overall achievement. The correlation between the Metropolitan Achievement Test and the Qualitative Scoring System was significantly higher than that of the Metropolitan Achievement Test and the Developmental Scoring System (Brannigan et al., 1995).

Another study by Fuller and Vance (1995) found that the interscorer reliability of the Modified Version of the Bender-Gestalt Test was high for preschool children. Approximately 50 children were individually administered the Modified Version of the Bender-Gestalt Test, which were scored by two independent examiners who did not receive formal training in the Qualitative Scoring System. Correlations were approximately .89 indicating a strong agreement between the examiners and adequate inter-rater reliability (Fuller & Vance, 1995).

The Modified Bender-Gestalt Test has also been used to predict academic performance in children from Hong Kong. Almost 750 children were used in this study by Chan (2000). The children were administered the Bender-Gestalt Test and the Standardized Attainment Test, a test used in Hong Kong to assess childrens' academic performance in English, Chinese, and Math. The Bender-Gestalt was scored using both the Developmental Scoring System and the Qualitative Scoring System. The Qualitative Scoring System correlated significantly higher than the Developmental Scoring System with the Standardized Attainment Test (Chan, 2000). Also, the visual-motor integration correlated higher with Chinese subtests, which may reflect a greater need for these skills in learning the Chinese language (Chan, 2000).

## The Bender-Gestalt II

Because of numerous studies indicating that the Qualitative Scoring System used with the Modified Version of the Bender-Gestalt Test was a better predictor of school achievement, the Bender-Gestalt II was developed. There were three main goals of the revision of the Bender-Gestalt Test. First, the measurement scale needed to be extended so as to have a lower floor and higher ceiling. Second, a large representative norming sample was needed to reflect the visual-motor skills of individuals at all ages. Third, the original gestalt figures needed to be reviewed so as to determine whether they were appropriate for the new test (Brannigan & Decker, 2003).

To determine the degree of difficulty for the items, the nine original gestalt figures were analyzed using Rasch analysis, which independently estimates both item difficulty and subject ability (Brannigan & Decker, 2003). Using this analysis, items are ranked by degree of difficulty. Items that needed to be easier or harder were then developed so as to extend the measurement scale (Brannigan & Decker, 2003).

The Bender-Gestalt II was normed on a sample of 4,000 children and adults, based on the United States 2000 census. Age range of the sample was from 4 years to over 85 years. Additional samples were also collected to include individuals with mental retardation, learning disabilities (i.e. reading, writing, and math), attention-deficit hyperactivity disorder (AD/HD), autism, and Alzheimer's disease. *Gifted* individuals were also selected to be part of an additional sample (Brannigan & Decker, 2003).

To extend the measurement scale, new items were created. Items both easier and harder than the original nine items were made. These were then tested on individuals and analyzed using Rasch analysis. Young children, in general, do very poorly on the more difficult items, so it is not necessary to administer those items to children below the age of 8. Children above the age of 8 and adults, in general, perform very well on the easier items. Therefore children under the age of 8 are administered new, easier items as well as the original nine gestalt figures. Children above the age of eight and adults are administered the original figures as well as new, more difficult items (Brannigan & Decker, 2003).

#### *New Features of the Bender-Gestalt II*

Several new features were also added to the Bender-Gestalt II. These include a recall procedure, an observation form, motor and perception tests, and a global scoring system. A recall procedure was included in the standardization (Brannigan & Decker, 2003). This recall

phase, completed after the copy phase, consists of asking the child to draw as many figures as s/he can remember.

An observation form was included as well so the examiner can take notes on how the child drew the figures and the order in which the figures were drawn during the recall phase. Very short motor and perception tests were added to detect any possible deficits in either of those skills that may hinder the child's ability to perform on the Bender-Gestalt II (Brannigan & Decker, 2003). This information can also be helpful in making decisions about a child's motor, perceptual, and integrative abilities.

The new global scoring system is based mostly on the Qualitative Scoring System developed by Brannigan and Brunner (1989) (as cited in Brannigan & Decker, 2003). Research on this scoring system has shown it to be a reliable and accurate predictor of school achievement. The Bender-Gestalt II Global Scoring System was adapted and simplified from the Qualitative Scoring System. Scores for each figure are based on a 5-point rating scale ranging from 0 to 4. These scores are then totaled for total test score. The scoring system is as follows:

0 represents no resemblance to the design, a random drawing, or scribbling

1 represents a slight or vague resemblance to the figure

2 represents some or a moderate resemblance

3 represents a strong or close resemblance

4 represents a nearly perfect reproduction (Brannigan & Decker, 2003).

*Reliability and Validity of the Bender-Gestalt II*

Brannigan and Decker (2003) reviewed the reliability and validity of the Global Scoring System before the Bender-Gestalt II was published. Included in the manuals are the results of these reviews. Reliability indices included interrater consistency, internal consistency, and test-retest. Several validity studies were done comparing the Bender-Gestalt II to measures of visual-motor skills, academic skills, and cognitive abilities.

Several studies were done to test the interrater reliability of the copy and recall phases of the Bender-Gestalt II. These were done using experienced examiners as well as novice examiners. Correlations for all possible combinations were compared and found that the interrater correlation was at least .85 for the novice examiners and averaged .90 for the experienced examiners for the copy phase. The correlation coefficients for the recall phase ranged from .92 to .97, indicating good interrater reliability (Brannigan & Decker, 2003).

Internal consistency was assessed by a split-half method used on the copy phase. Results yielded a reliability coefficient of .91, which indicates internal stability among the designs (Brannigan & Decker, 2003). To test temporal stability, approximately 200 individuals were administered the Bender-Gestalt II and then readministered the Bender-Gestalt II approximately two to three weeks later. The average correlation between the first and second administration was .85 for the copy phase and .83 for the recall phase, indicating an acceptable correlation (Brannigan & Decker, 2003).

The new Global Scoring System was compared to the Developmental Bender Scoring System (Koppitz, 1963). This validity showed that correlations were .80 for the copy phase and .51 for the Recall phase. The Bender-Gestalt II was also compared to the Beery-Butktenica

Developmental Test of Visual-Motor Integration, Fourth Edition, Revised (VMI) and the correlations were .65 for the copy phase and .44 for the recall phase. The comparisons to other visual-motor tests indicate that they are significantly related to each other. The recall phase is less related (Brannigan & Decker, 2003).

*Academic achievement.*

The Bender-Gestalt II was compared to the Woodcock-Johnson III Tests of Achievement (WJ III ACH) and the Wechsler Individual Achievement Test—Second Edition (WIAT-II). The broad cluster scores of each test were compared to the copy and recall phase of the Bender-Gestalt II. The correlations for the copy phase with the WJ III ACH ranged from .27 to .53 and for the recall phase from .25 to .49. The highest correlations were with the Reading Comprehension cluster (.53 for the copy phase and .49 for the recall). The correlations between the Bender-Gestalt II and the WIAT-II composites ranged from .20 to .47 for the copy phase and .17 to .31 for the recall phase. The highest correlations were with the Written Language composite with a .47 correlation with the copy phase; however, the recall phase had only a .17 correlation (Brannigan & Decker, 2003). Overall, the Bender-Gestalt II showed a significant correlation with these academic achievement tests and is correlated with reading and math composite scores as well as with total achievement scores. While the Bender-Gestalt II may not correlate very highly with all academic subjects, it does have moderate correlations with Written Language, especially with the copy phase. Both of these tasks require similar abilities, such as fine motor control and the ability to copy figures or in the case of writing, letters.

*Cognitive ability.*

The Bender-Gestalt II was also compared to the Stanford-Binet Intelligence Scales, Fifth Edition (SB5), the Wechsler Intelligence Scale for Children-Third Edition (WISC-III), and the

Wechsler Adult Intelligence Scale-Third Edition (WAIS-III). Correlations were found between the Bender II and these intelligence scales which were broken down into the Nonverbal or Performance IQ, the Verbal IQ, and the Full Scale IQ. Overall, moderate correlations were found. The correlations were higher on measure of nonverbal intelligence than on measures of verbal intelligence. Correlations were also higher on the copy phase than on the recall phase. This indicates that the Bender-Gestalt II is correlated with measures of intelligence. (Brannigan & Decker, 2003).

### An Introduction to Executive Functions

Executive functions have been defined by Welsh, Pennington, & Groisser (1991) as “goal-directed behavior, including planning, organized search and impulse control” (p. 131). Other elements of executive functions include anticipation, planning, inhibition, self-regulation, cognitive flexibility, use of attention, and utilization of feedback (Anderson, 2002). Gioia, Isquith, Guy, and Kenworthy (2000a) characterize executive functions as an umbrella term comprised of a group of interrelated functions that are responsible for purposeful, goal-directed, and problem-solving behavior.

Executive functions have long been associated with the functions of the frontal lobe. Deficits in executive skills often follow damage to the prefrontal cortex (Anderson, 2002). One of the most notable cases of prefrontal cortex damage was that of Phineas Gage, a railroad worker, who in 1848 was struck with a tamping iron. The tamping iron entered just above Gage’s upper cheek, and exited through the top of his head. Gage survived the accident, but according to the American Phrenological Journal (as cited in Macmillan, 2000), “[Gage] was gross, profane, coarse, and vulgar, to such a degree that his society was intolerable to decent people. Before the injury he was quiet and respectful” (p. 94).



Prefrontal cortex damage has also been studied in children. Grattan and Eslinger (1991) examine several case studies of children who have sustained damage to their frontal lobes. While the etiologies, ages, and sexes of the children vary, several similarities are apparent. The children were noted to have impairments in planning, impulse control, cognitive flexibility, and difficulty in social situations (Grattan & Eslinger, 1991). The full effects of childhood frontal lobe lesions are not always apparent for months or even years after the injury. This is due to the developmental nature of executive functions as well as the fact that the demand for the executive functions is not expected until later in life (Grattan & Eslinger, 1991).

#### The Development of Executive Functions in Children

Executive functions develop throughout childhood and adolescence. Most tests of executive functioning are not appropriate for young children. Epsy (1997) used the Shape School to assess inhibition and switching processes in preschool children. Inhibition and switching tasks are presented as a story about colorful shapes. Children then perform tasks such as naming the different colors and naming children with happy faces, but not those with frustrated faces. Tasks become more difficult for older children. Epsy (1997) found that four-year-olds were better able to inhibit their responses than three-year-olds, while switching efficiency improved between the ages of four and five. Diamond and Taylor (1996) also found inhibition to develop during the preschool years. They used the tapping test with children between the ages of 3 ½ and 7, which consists of the child tapping once when the examiner taps twice and tapping twice when the examiner taps once. Children were better able to follow both rules as they got older, with most improvement seen by the age of 6.

Most of the gains in executive functions seem to occur in middle childhood. Brocki and Bohlin (2004) looked at the executive functions in children between the ages of 6 and 13. Their

sample of children was divided into four age groups: 6 to 7.5 years, 7.6 to 9.5 years, 9.6 to 11.5 years, and 11.6 to 13.1 years. On a test of disinhibition, children in the 7.6 to 9.5 and 9.6 to 11.5 year age groups showed the most improvement. This is consistent with Levin et al. (1991) who found a major reduction in false-positive errors in inhibition by age 12. Further improvement was not seen in the fourth age group. Children in the first and second age groups had the most improvement in the speed/arousal factors. Significant changes in working memory and fluency occurred around ages 8 and 12 years. Welsh, Pennington, & Groisser (1991) found that complex planning skills were not at adult levels by the age of 12 and that these must continue to develop throughout adolescence.

Anderson, Anderson, Northam, Jacobs, and Catroppa (2001) found that in late childhood and early adolescence, the development of executive functions tended to be flat. The most significant development was in the attentional control-processing speed. These tasks consisted of repeating numbers forward, backward, and listening for two “fives” presented twice in a tape recording and then identifying the number that preceded the fives. Improvement was also seen in the children’s planning and problem-solving skills. Levin et al. (1991) also found major gains in the areas of cognition and memory organization in adolescents.

#### Executive Functions and Their Relationship to Academics

There are few published studies examining reading ability and executive functioning. Existing studies show there is no correlation between the two. One study examined planning difficulties in children with reading disabilities. Reading disabled children and their non-disabled peers completed the Tower of Hanoi, a test of executive functioning that specifically measures strategic planning. No differences were found in the children’s ability to develop and implement efficient strategies when solving novel problems (Condor, Anderson, & Saling,

1995). However, younger children with reading disabilities needed more time and practice to perfect appropriate strategies. van der Sluis, de Jong, van der Leij (2004) also found that reading disabled children did not exhibit problems in their executive functions.

While there does not appear to be a relationship between reading ability and executive functions, executive functions do seem to be related to mathematical ability. Bull and Scerif (2001) found that children with lower mathematic ability have more difficulty on tasks measuring executive functions. Children in their study were given four measures of executive functioning (Wisconsin Card Sorting Test – Revised and Expanded (WCST), Stroop Task, Dual-task Performance, and Counting Span) and the results were correlated with their mathematic ability. Each task was examined and different correlations were found. For example on the WCST, children with a lower mathematic ability have difficulty inhibiting a learned strategy and switching to a new one. On the Counting Span task there was a significant positive correlation between mathematic ability and counting span. Bull, Johnston, and Roy (1999) also used the WCST with children of lower mathematical ability. They found these children had a higher percentage of both perseverative and nonperseverative errors. Inhibitory control was also found to be related to emerging math skills in preschoolers in a study by Epsy et al. (2004). This relationship was large even when the effects of the child's age, estimated verbal intelligence, and mother's educational background were controlled for. Working memory was also found to be related to the emergent math skills of young children but to a lesser extent (Epsy et al., 2004).

Walsh (1978) discovered that adults who acquire frontal lobe damage are generally spared their primary sensory and motor areas, as well as their intelligence, as measured by psychometric batteries (as cited in Welsh, Pennington, and Groisser, 1991; Welsh & Pennington, 1988). Stuss and Benson (1986) document case studies in which children and adults with frontal

lobe damage have average intelligence as measured by IQ tests. Also documented were cases in which adults did experience deterioration in intelligence. Stuss and Benson conclude that inadequate definitions of intelligence and cognition make it difficult to determine the relationship between intelligence and the frontal lobes (1986).

In a study of over 7,000 healthy adults, Salthouse found that many variables suggested to measure executive functioning were closely related to cognitive abilities in the areas of reasoning and perceptual speed (2005). Grattan and Eslinger (1991) found through their case studies of children with frontal lobe lesions that most of these children, regardless of age of lesion, demonstrated intellect in the average range. Welsh, Pennington, & Groisser (1991) also found preliminary evidence that executive function skills in 6 to 12-year-old children are not synonymous with general intelligence. These authors suggested that executive function is a domain of cognition that is relatively independent of IQ.

In a study examining executive functions and IQ in 13 to 16 year old children, few significant correlations were found. Low correlations between the Verbal IQ and Full Scale IQ on the Wechsler Intelligence Scale for Children – Revised (WISC-R) and the Wisconsin Card Sorting Task perseverative errors were found (Ardila, Pineda, & Rosselli, 2000). Perhaps Lhermitte et al. 1972 (as cited in Stuss & Benson) states it best: “the frontal lobe...is not the seat of intelligence, but it intervenes in all intellectual activities” (p. 416).

### *Visual-Motor Integration*

There are no studies to date that look at visual-motor integration and executive functions. However, one study looked at the relationship between motor coordination and executive functioning. Piek et al. (2004) found that scores on the Neurodevelopmental Index of the McCarron Assessment of Neuromuscular Development (McCarron, 1997 as cited in Piek et al.,

2004) were negatively correlated with scores on the Trailmaking/Memory Updating Task, which is a measure of working memory and inhibition. This indicates that children At-Risk for motor coordination disorders did more poorly on measures of working memory and inhibition.

However, it should be noted that only the timing measures were influenced by the child's motor ability. For these children, a measure of executive functioning that does not require proficient motor ability should be utilized.

#### The Behavior Rating Inventory of Executive Functions

Measuring one's executive functions can become time consuming and laborious because one measure of executive functions does not necessarily encompass all that makes up what is known as executive functions. For example, the Wisconsin Card Sorting Task (WCST) measures the ability to shift from one strategy to the next. Hughes and Graham (2002) note a child's limited language abilities as a problem when investigating executive functioning in childhood. Most obvious is the child's ability to comprehend the instructions necessary to understand the task. Also, many measures of executive functioning depend on automatic written language like the Stroop test in which reading the word "blue", for example, written in a different color would be automatic or the Trail-making test in which an alphabetic sequence is interspersed with a numeric sequence (Hughes & Graham, 2002).

Donders (2002) touches on the paucity of the measures specifically designed for children and adolescents and that accurately reflect children's day-to-day behavior. There are two problems associated with most testing situations: excessive cues and structure to help initiate and maintain the child's behavior (Sbordone, 1996 as cited in Silver, 2000) and the fact that responses in testing are often less complex than required in the natural environment (Cripe, 1996 as cited in Silver, 2000). In a testing situation, the examiner functions as the child's executive

functions by telling the child when to start and stop and what to focus on, providing materials, limiting the amount of distractions and setting limits on continuing when the child fails an item, which makes self-monitoring unnecessary (Silver, 2000).

The Behavior Rating Inventory of Executive Function (BRIEF) (Gioia, Isquith, Guy, & Kenworthy, 2000a) was designed to address some of these concerns. The BRIEF is a rating scale that assesses children's everyday behavior in their natural settings and can be completed by a parent or teacher. The BRIEF examines the emotional, behavioral, and metacognitive skills that describe executive abilities. The eight primary scales of the BRIEF make up two summary scales. The Inhibit, Shift, and Emotional Control scales make up the Behavioral Regulation Index and the Initiation, Working Memory, Planning, Organization of Materials, and Monitoring scales comprise the Metacognition Index. Together, the indices make up the Global Executive Composite (see Appendix 2 for descriptions).

The BRIEF, which is made up of 86 questions, has two forms: one for teachers and one for parents. Questions are answered on a three-point Likert type scale (Never, Sometimes, and Often) and respondents with at least a fifth-grade education will find the questions and instructions easy to read and understand. Completion of the questionnaire takes approximately 10 to 15 minutes. Scoring can be done by hand or with the computer scoring program and yields standard scores. Along with the eight executive function scales and three index scores, there are also two validity scales: the Negativity Scale (Acceptable, Elevated or Highly Elevated) and the Inconsistency Scale (Acceptable, Questionable, or Inconsistent). These validity scales are used to detect bias associated with the rating scales (Gioia, Isquith, Guy, & Kenworthy, 2000b).

### Further areas of research

The Bender-Gestalt Test has been around for over 60 years and has maintained its popularity despite not having a well-developed scoring system. With the second edition of the Bender-Gestalt Test, a new Global Scoring System has been developed to score gestalt figures as Bender intended—as wholes, rather than in parts. Because this is a new version of the test, the only studies to analyze its validity as compared to the older Developmental Scoring System have been done by the authors of the Bender-Gestalt II (Brannigan & Decker). The purpose of this study was to assess the extent of association between Koppitz's Developmental Scoring System and the new Global Scoring System. Further, is the Bender-Gestalt II Global Scoring System more related to academic achievement than the Koppitz's Developmental Scoring System?

Measuring children's executive functions have been gaining the interest of school psychologists in recent years because of the relationship it has with a child's academic performance. Good executive functions enable a child to listen attentively, complete his work, and transition easily. The second aim of this study, therefore, is to find the correlation between executive functions and visual-motor integration, specifically the Bender-Gestalt Test. Also, do executive functions relate to academic performance?

## Method

### *Participants*

Students in grades three and four from an elementary school in the public school system in Western New York participated in the study. This population consisted primarily of upper-middle-class. A total of 82 children completed the assessment measures and 80 parents completed the Behavior Rating Inventory of Executive Function questionnaire. The overall sample of 82 students was comprised of 44 females and 38 males. There were 46 participating 3<sup>rd</sup> graders and 31 4<sup>th</sup> graders (the grade for three students was undetermined). Academic scores were collected for 56 of the children due to the availability of their test scores.

### *Instruments*

*Bender Visual-Motor Gestalt Test (Bender, 1938).* Figures were scored using the Koppitz Developmental Scoring System (Koppitz, 1963) and the Bender-II scoring system (Brannigan and Decker, 2003).

*Behavior Rating Inventory of Executive Function (BRIEF)* (Gioia, Isquith, Guy, & Kenworthy, 2000a).

*Cognitive Assessment System.* Planned Connections, a subtest of the Cognitive Assessment System (CAS) (Naglieri & Das, 1997) was also administered.

Academic performance scores were obtained from the children's school. The New York State English Language Arts and the New York State Mathematics were used to assess fourth graders performance. For third graders, the Tests of New York State Standards in English Language Arts and Mathematics were used to assess their academic performance.



*Procedures*

All parents of children in the 3rd and 4th grades received consent forms during the spring of 2005 and again in the fall. A total of 110 parental permission forms were returned and these parents received a BRIEF questionnaire. These were returned when the child came in for testing or were given to the child's homeroom teacher. Testing took place before school in the cafeteria in groups of 15 to 25 children. Two testing sessions took place during June of 2005 and two during November of 2005. The Bender-Gestalt II cards were copied onto overheads and used with an overhead projector. The Bender-Gestalt II was given using the standardized instructions with the exception of the overhead modification. No difference in scores has been found when the Bender-Gestalt Test is administered in a group (Bain, 1971; Jacobs, 1971; McCarthy, 1975). Similar results were found when using the modified version of the Bender-Gestalt Test, which uses a more global scoring system like the Bender-II (Brannigan & Brannigan, 1995). The CAS subtest was also administered. Instructions were given orally to the group and students were timed by school psychology graduate students in groups of two or three.

## Results

Descriptive statistics were calculated for the BRIEF and the Bender-Gestalt Test.

Overall, similar means and standard deviations were found for both 3<sup>rd</sup> and 4<sup>th</sup> graders. The mean for the Copy subtest of the Bender-II was a standard score of 115 for 3<sup>rd</sup> graders and 113 for 4<sup>th</sup> graders. The means for the Copy portion when scored with the Koppitz Developmental Scoring System was 103 for 3<sup>rd</sup> graders and 102 for 4<sup>th</sup> graders, which are approximately the means developed by Koppitz. The mean for the Bender-II Perception subtest was 10, which is also the ceiling for the subtest. The mean for the Motor subtest was 11. The mean number of emotional indicators was 3 and 2 for 3<sup>rd</sup> and 4<sup>th</sup> graders respectively. These results are shown in Table 1.

Means and standard deviations were also calculated for the BRIEF. Overall, the results for both 3<sup>rd</sup> and 4<sup>th</sup> graders were similar with means and standard deviations approximately 50 and 10 respectively. Means and standard deviations for the CAS Planned Connections subtest were 11 and 3 respectively for both grades. These results are displayed in Table 2.

Pearson correlation coefficients were calculated to determine the relationship between the Koppitz Developmental Scoring system of the Bender-Gestalt Test and the Global Scoring System of the Bender-II. These results are shown in Table 3. Significant correlations were found between the Koppitz Developmental Scoring System and the Copy ( $r = .70, p < .01$ ), Recall ( $r = .51, p < .01$ ), and Motor subtests of the Bender-II ( $r = .32, p < .01$ ). Significant correlations were not found between the Bender-II Scales and Koppitz Emotional Indicators for the Bender-Gestalt Test.

To address the research question of whether a relationship between visual-motor integration and executive functioning exists, Pearson correlation coefficients were calculated and

are shown in Table 4. The eleven scales on the BRIEF (Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Organize Materials, Monitor, Behavioral Regulation Index, Metacognition Index, and Global Executive Composite) and the Planned Connections subtest of the CAS were used as measures of executive functioning. The Bender-II subtests (Copy, Recall, Motor, Perception) and the Koppitz Developmental Scoring System for the Bender-Gestalt Test, as well as Koppitz Emotional Indicators were used as measures of visual-motor integration. Moderate correlations were found that were significant at the .01 and .05 levels. The Copy subtest from the Bender-II was negatively correlated with the following scales: Initiate ( $r = .30, p < .01$ ), Working Memory ( $r = .25, p < .01$ ), Plan/Organize ( $r = .36, p < .01$ ), Monitor ( $r = .33, p < .01$ ), Metacognition Index ( $r = .31, p < .01$ ), Global Executive Composite ( $r = .29, p < .01$ ). The Copy subtest of the Bender-II was positively correlated with the Planned Connections subtest ( $r = .27, p < .05$ ) as was Recall subtest of the Bender-II ( $r = .34, p < .01$ ). The Koppitz Developmental Scoring System of the Bender-Gestalt Test was weakly negatively correlated with two measures of executive functioning: Plan/Organize ( $r = .23, p < .05$ ) and Monitor ( $r = .23, p < .05$ ). Koppitz Emotional Indicators were positively correlated with the Organize Materials scale ( $r = .22, p < .05$ ).

Table 5 shows the relationship between visual-motor integration and academics (specifically reading and math) was also examined. Significant correlations were not found between visual-motor integration and reading; however, significant correlations were found between the Copy subtest of the Bender-II and math scores ( $r = .33, p < .05$ ). Similar correlations were also found between the Koppitz Developmental Scoring System and math scores ( $r = .34, p < .05$ ).

Table 6 displays the relationship between academics and executive functioning. There were few correlations between executive functioning and reading; however, all but one measure of executive functioning correlated significantly with math. Reading scores correlated with executive functioning for the following scales: Initiate ( $r = .28, p < .05$ ), Plan/Organize ( $r = .30, p < .05$ ), and Planned Connections ( $r = .42, p < .01$ ). Math scores correlated with Inhibit ( $r = .28, p < .05$ ), Shift ( $r = .29, p < .05$ ), Emotional Control ( $r = .32, p < .05$ ), Initiate ( $r = .34, p < .05$ ), Working Memory ( $r = .37, p < .05$ ), Plan/Organize ( $r = .36, p < .01$ ), Monitor ( $r = .40, p < .01$ ), Behavioral Regulation Index ( $r = .35, p < .01$ ), Metacognition Index ( $r = .28, p < .05$ ), Global Executive Composite ( $r = .34, p < .05$ ), and Planned Connections ( $r = .47, p < .01$ ).

#### *Further Analysis*

In a further analysis, executive functioning scales and visual-motor integration subtests were combined and examined in order to determine which were better predictors of academic functioning. At this time, information was available only for 3rd graders. Math scores were predicted by the Bender-Gestalt Test's emotional indicators and the Monitor scale on the BRIEF. Multiple Regression was significant for 55% of the variance ( $F(2, 14) = 8.64, p < .01$ ). Reading scores were predicted by Bender II's motor subtest and the Shift scale on the BRIEF. Multiple Regression was significant for 49% of the variance ( $F(2, 14) = 6.75, p < .01$ ).

## Discussion

This study had two main goals. First, it sought to examine the relationship between the recently updated Bender-II, which features a fundamentally different scoring system from the Koppitz Developmental Scoring system that was developed for the first Bender-Gestalt Test. Second, it examined visual-motor integration with executive functioning, two skills thought to be important in a child's academic functioning.

One of the most noticeable aspects of the descriptive statistics is the means for the Bender-II Copy and Recall subtests. While the manual reports Standard Scores, which have a mean of 100 and a standard deviation of 15, in this sample, the means across 3<sup>rd</sup> and 4<sup>th</sup> graders for the Copy and Recall subtests were 113 (with the exception of the mean for 3<sup>rd</sup> graders for the Copy subtest where the mean was 115). Because of the higher socioeconomic status of the sample, it could be seen as a function of the sample. However, the mean when using the Koppitz Developmental Scoring System was 103 for 3<sup>rd</sup> graders and 102 for 4<sup>th</sup> graders, which is more consistent with Standard Scores. The standard deviations were both 15, which is also consistent with Standard Scores. This should be further evaluated with different populations of children.

Despite the difference between means in the Bender-II Copy subtest and the Koppitz Developmental Scoring System, they are still significantly correlated. This correlation is consistent with the reported correlations in the Bender-II manual. The correlation between the Bender-II Recall subtest and the Koppitz Developmental Scoring System found in this study is identical to the reported correlation in the Bender-II manual (Brannigan & Decker, 2003). A moderate correlation was found between the Koppitz Developmental Scoring System and the

Motor subtest of the Bender-II. There were no correlations between the Koppitz Developmental Scoring System and the Perception subtest.

Standard scores are not available for the Motor and Perception subtests. Instead, percentiles are given depending on the number of questions answered correctly. The Motor and Perception subtests are to help determine if a child has difficulty primarily with the motor aspect of the test or the perception aspect. The highest score obtainable on the Motor subtest is 12. For our sample, 85% of 3<sup>rd</sup> graders and 90% of 4<sup>th</sup> graders achieved a score of 11 or 12 indicating they are within the 75<sup>th</sup>-100<sup>th</sup> percentile for their age. For the Perception subtest, which has a high score of 10, 91% of 3<sup>rd</sup> graders and 97% of 4<sup>th</sup> graders achieved a 10. No child achieved a score less than 9. These subtests do not appear to distinguish between groups of children who may have difficulty with motor and/or perception at the 3<sup>rd</sup> and 4<sup>th</sup> grade levels. Further research for children in younger grades may show better variability of scores within these subtests.

The research question that sought to address the relationship between visual-motor integration, specifically the Bender-Motor Gestalt Test, and executive functions provided significant results. Several aspects of executive functioning are related to the Copy aspect of the Bender-II. These scales include the Initiate, Working Memory, Plan/Organize, Monitor, Metacognition Index, and Global Executive Composite Scales. These executive functions are necessary to perform well on the Bender-II; therefore, the higher the BRIEF scale score (indicating difficulty with the executive function), the lower the Bender-II score would be. The Initiate scale relates to a child's ability to begin a task or activity. A child with difficulty in this area may be slower to begin drawing their figures on the Bender-II.

Working Memory is necessary to hold information in one's mind for the purpose of completing a task. For example, working memory is crucial for following complex directions,

computing arithmetic problems, and solving multi-step problems. This is important during the copying phase of the Bender-II as the child has to look at the picture and then draw what he is seeing. While a child can refer back to the figure he is copying, he would benefit from being able to remember the drawing, thereby not continually interrupting his work to take another look.

The Plan/Organize scale measures a child's ability to determine a goal and then develop a strategy to achieve that goal. This is often seen when children have a large homework assignment where they have to figure out a plan of action. The Organize piece of this scale involves arranging information in an orderly way. "Organization also has a clerical component that is expressed, for example, in the ability to efficiently scan a visual array..." (Gioia, Isquith, Guy, and Kenworthy, 2000a p. 19). This component of the Plan/Organize scale is of particular importance for visual-motor integration in order for a child to correctly replicate the drawing.

The Monitor scale is also of utmost importance when it comes to visual-motor integration. This scale assesses a child's ability to check his work during or after finishing a task. If a child does not do this while copying figures in a visual-motor integration task, many more errors will be made. Children with poor monitoring skills often rush through their work, make careless mistakes and do not check their work when they have finished. Because the majority of the scales that make up the Metacognition and Global Executive Composite were negatively correlated with Bender II scores, these scales were also negatively correlated to the Bender II Copy subtest scores.

The Bender II correlates with several more scales of the BRIEF than the Koppitz Developmental Scoring System. This indicates that the Bender II may have greater utility in giving a general estimate of a child's executive functioning. As the Bender-Gestalt test is one of the top 10 instruments most given to assess children, adolescents and adults (Piotrowski, 1995),

when it is given, it can also be used to help determine if further assessment into the individual's executive functioning is warranted.

Children who scored high on the BRIEF Organize Materials scale, indicating a poorer ability to organize their materials, also had a higher number of emotional indicators. The Organize Materials scale assesses how neatly a child keeps their work, play, and storage spaces. One emotional indicator is a disorganized arrangement of the Bender figures. It could be that children who have difficulty organizing their things also have difficulty organizing their work.

Both the Copy and Recall subtests of the Bender II are related to the Planned Connections subtest of the CAS. Like the Copy subtest, this task also requires the child to visually scan an area efficiently in order to problem solve. The child must also be able to quickly recall the order of numbers and letters to be able to get to the end. This recall is also important in the Recall subtest in order to correctly redraw the figures that were just seen.

There are mixed results as to whether the Koppitz Developmental Scoring System is related to academics. This study lends support to its correlation with mathematics. The Bender-II was significantly correlated with math, but not reading. The Bender-II manual shows high correlations with reading, but this was using a different measure of reading, which could be why this study did not replicate that finding.

The BRIEF was also found to be related to academics, in particular, mathematics. The Initiate and Plan/Organize Scale were related to reading whereas the following scales were related to math achievement: Inhibit, Shift, Emotional Control, Initiate, Working Memory, Plan/Organize, Monitor, Behavioral Regulation Index, Metacognition Index, and the Global Executive Composite. This is consistent with the literature finding more connections between executive functions and math, than with reading. Planned Connections of the CAS was also



found to be related to reading and math. This is consistent with findings by Naglieri and Rojahn (2004).

Koppitz emotional indicators and the Monitor scale of the BRIEF were found to be the best predictors of math achievement. The ability to monitor one's behavior and work is crucial when solving math problems. In order to correctly solve math problems, children must not rush through their work and must monitor themselves to correct any errors that may have been made.

The Motor subtest of the Bender II and the Shift scale of the BRIEF were the best predictors of reading achievement. Shifting includes the ability to transition easily, alternate attention from one task to another, change focus from one topic to another, and have flexibility when problem solving. These features are important when reading and comprehending written text. A child must be able to easily read through a passage and then think about what he has read in order to answer questions about it. Children must often infer the answer to a reading comprehension question and this requires problem-solving flexibility by looking outside the box.

### *Limitations*

One limitation of this study is the small sample size. Overall, only 80 students and parents completed both aspects of testing. These students were all from one school in an upper-middle-class neighborhood. Because this small sample is made up of higher achieving students, it is unclear if this would generalize to all students, especially those in lower socioeconomic areas. Also, these students were only in grades three and four and between the ages of 8 and 10. Studies examining the relationship between visual-motor integration and executive functioning in younger children should be examined to see if the same results are found.

An additional limitation is the use of the BRIEF as a measure of executive functioning. Because a parent is completing the questionnaire, they may be more likely to skew the results by

portraying a more negative or positive view of their child depending on their feelings for their child. This limitation is also noted in Denckla's 2002 commentary on the BRIEF.

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Table 1

*Descriptive Statistic for the Bender-Gestalt Test by Grade Level*

Bender Scale	3 <sup>rd</sup> Grade (n=46)		4 <sup>th</sup> Grade (n=31)	
	Mean	SD	Mean	SD
Bender-II Copy	115	13	113	13
Bender-II Recall	113	19	113	15
Bender-II Motor	11	1	11	2
Bender-II Perception	10	0.29	10	0.18
Bender Emotional Indicators	3	1	2	1
Bender Koppitz	103	15	102	15

Table 2

*Descriptive Statistics of Executive Functions (EF) by Grade Level*

EF Scale	3 <sup>rd</sup> Grade (n=45)		4 <sup>th</sup> Grade (n=30)	
	Mean	SD	Mean	SD
<b>BRIEF</b>				
Inhibit	50	10	50	10
Shift	49	10	51	10
Emotional Control	50	12	48	9
Initiate	48	9	51	11
Working Memory	50	9	54	13
Plan/Organize	46	8	54	13
Organize Materials	51	9	54	9
Monitor	46	9	53	11
Behavior Regulation Index	49	11	50	9
Metacognition Index	43	9	52	14
Global Executive Composite	45	9	51	12
<b>CAS</b>				
Planned Connections	11	3	11	3

Table 3

*Correlations Between the Bender-II and Koppitz Developmental Scoring System and Emotional Indicators*

Bender-II Scales	Kopptiz Developmental Scoring System	Emotional Indicators
Copy	.70**	-.20
Recall	.51**	.17
Motor	.32**	-.13
Perception	-.01	-.12

\*\*  $p < .01$

\*  $p < .05$

Table 4

*Correlations between the Bender and Executive Functioning (EF)*

EF Scales	Bender Scales				
	Copy	Recall	Motor	Perception	E.I.
<b>BRIEF</b>					
Inhibit	-.15	-.12	.09	.05	.12
Shift	-.13	-.12	.11	.04	-.06
Emotional Control	-.21	-.15	.09	-.01	.07
Initiate	-.30**	-.21	-.00	.14	-.05
Working Memory	-.25**	-.16	-.02	.08	.16
Plan/Organize	-.36**	-.17	-.04	.07	.06
Organize Materials	-.19	-.01	-.09	.04	.22*
Monitor	-.33**	-.07	-.03	.01	.12
Behavioral Regulation Index	-.20	-.15	.11	.03	.07
Metacognition Index	-.31**	-.07	.03	.05	.15
Global Executive Composite	-.29**	-.10	.06	.05	.12
<b>CAS</b>					
Planned Connections	.27*	.34**	.13	-.03	.01

\*\*  $p < .01$ \*  $p < .05$

Table 5

*Correlations Between the Bender and Reading and Math Achievement*

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Bender-II Scales	Reading	Math
Copy	.26	.33*
Recall	.23	.09
Motor	.13	.06
Perception	-.20	.04
Koppitz Developmental	.25	.34*
Scoring System		
Emotional Indicators	.01	-.18

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\*\*  $p < .01$

\*  $p < .05$

Table 6

*Correlations Between Executive Functions and Reading and Math Achievement*


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Executive Functions	Reading	Math
BRIEF		
Inhibit	-.15	.28*
Shift	.22	.29*
Emotional Control	-.25	-.32*
Initiate	-.28*	-.34*
Working Memory	.12	-.37*
Plan/Organize	.30*	-.36**
Organize Materials	-.03	-.15
Monitor	-.26	-.40**
Behavioral Regulation Index	-.24	.35**
Metacognition Index	.13	.28*
Global Executive Composite	-.18	.34*
CAS		
Planned Connections	.42**	.47**

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\*\* p &lt; .01

\* p &lt; .05

## APPENDIX 1

Twenty deviations and distortions used as the initial scoring categories in Koppitz's

Developmental Scoring System

- (a) distortion of shape
- (b) rotation
- (c) erasures
- (d) part missing
- (e) confused order
- (f) overlapping of figures
- (g) compression
- (h) second attempt
- (i) perseveration
- (j) circles or dashes for dots
- (k) wavy line
- (l) shape of circles
- (m) deviation in slant
- (n) dashes or dots for circles
- (o) blunting
- (p) incorrect number of dots
- (q) square and curve not joined
- (r) angles in curve
- (s) extra or missing angles
- (t) boxes around the figures

## APPENDIX 2

## Descriptions of the eleven scales on the Behavior Rating Inventory of Executive Function

- (a) The Inhibit scale assesses inhibitory control, which is the ability to inhibit, resist, or not act on an impulse, as well as one's ability to stop his own behavior at the appropriate time.
- (b) The Shift scale measures the ability to transition between activities, situations or aspects of a problem as the circumstances demand.
- (c) The Emotional Control scale takes into account the emotional aspects of executive functions and measures a child's ability to regulate their emotional responses.
- (d) The Initiate scale assesses a child's ability to begin tasks and activities as well as their ability to independently produce responses, ideas, or strategies to solve problems.
- (e) The Working Memory scale assesses a child's capacity to hold information in his mind for the purpose of finishing a task.
- (f) The Plan/Organize scale has two components, Plan and Organize, which together measure the ability to manage current and future-oriented task demands. The plan component measures one's the ability to anticipate future events, set goals, and develop appropriate steps to carry out a task or activity. The organize component of this scale relates to the ability to order information and to understand main ideas of concepts when learning or communicating information.
- (g) The Organization of Materials scale measures how neat and orderly a child keeps his work, play, and storage spaces such as desks and bedrooms.



- (h) The Monitor scale assesses a child's ability to check his work during or after completing a task to ensure his attainment of the goal.
- (i) The Behavioral Regulation Index is made up of the Inhibit, Shift, and Emotional Control Scales.
- (j) The Metacognition Index is made up of the Initiate, Working Memory, Plan/Organize, Organization of Materials, and Monitor scales. This scale relates to a child's ability to solve problems in a variety of situations.
- (k) The Global Executive Composite is a summary score that includes all eight of the clinical scales on the BRIEF.